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ABSTRACT

How New Jersey schools are actually using computers and incorporating the technology into their curricula is the subject of this report. Following an introductory statement in chapter 1, chapter 2 explains several important issues and concepts related to computer use in schools. Chapter 3 describes the educational uses of computers in New Jersey's schools, drawing on a survey of all districts and on interviews in selected districts. Inequality in access to computers is touched on here. Chapter 4 provides an overview of what is occurring in this area in several states regarded as leaders in the uses of computers in schools. Chapter 5 describes the extent of the New Jersey State government's involvement and leadership in computer technology in education. Chapter 6, the conclusion, reviews a number of problems found in the survey upon which the report is based. These include (1) unequal resources, with the greatest access to and use of computers concentrated in wealthy suburban districts; (2) inadequate information sharing and a lack of cooperation among districts regarding computers; (3) absence of clearly defined goals for the technology; and (4) heretofore insufficient leadership and support by the state government. A number of recommendations are offered to counter these problems. (CMG)

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Computers in the Classroom: A Program for New Jersey

Working Paper No. 4

By Stuart Senator, Frank Trinity,
and Richard W. Roper

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Foreword

New Jersey parents of school-age children, like parents across the nation, are becoming aware of a new phenomenon in education. At home their youngsters' conversation is laced with terms that most parents find completely unfamiliar. Words like "LOGO," "turtle," "CPU," "software," "BASIC," and "modem" are common in the speech of a growing number of youngsters. These terms relate to the daily activities of a large number of today's schoolchildren, as they are associated with the instructional uses of computers in the classroom.

Providing students of all ages with exposure to computers, offering instruction in the use of the technology, and using computers as a teaching tool are increasingly regarded as essential components of an up-to-date school curriculum. The speed with which the technology has begun to take hold in the classroom is a cause of concern among some educators who feel too little is known about the true educational value of computers. Yet, few question the responsiveness of those students exposed to the technology.

This report of the Council on New Jersey Affairs looks at the classroom use of computers in the schools of our state. It provides a glimpse of what some districts are doing and how they are going about it. We have not attempted to evaluate the quality of the programs—that task we leave to others. Our task is simply to attempt to determine whether and to what extent New Jersey school districts are participating at this new frontier of education.

The Council appointed a subcommittee, chaired by John D. Feehan and including Gregory Anrig, Raymond Bateman, Edithe Fulton, Louis Gambaccini, Richard P. Nathan, and Mary Roebling, to provide oversight for this project and to review the final paper. I

wish to thank the members of the subcommittee, and especially John Feehan, for their contributions of time and ideas.

Robert V. Van Fossan
Chairman,
Council on New Jersey Affairs

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Listing all the individuals who contributed in various ways to the development of this working paper would require several pages. Since the beginning of the project in May 1983, many individuals have provided information, advice, and assistance. We appreciate their contributions. Several people, however, must be mentioned because of their support throughout the whole course of the project. Chief among them is Richard P. Nathan, director of the Princeton Urban and Regional Research Center and member of the Council. His advice, guidance, and encouragement were invaluable in preparing this paper. The Council subcommittee, with John Feehan as chair, and Gregory Anrig, Raymond Bateman, Edithe Fulton, Louis Gambaccini, Richard P. Nathan, and Mary Roebling, was a supportive oversight group.

Martin Schneiderman, director of the Computer Lab at Educational Testing Service, provided early and continuing advice about successful programs and knowledgeable people in other states. Peter Walling, of the New Jersey Department of Education, was equally helpful in guiding us to New Jersey school districts working to develop computer education programs.

Ms. Bobby Goodson, president of Computer Using Educators and a teacher in the Cupertino, California public school system, proved to be a mine of information about the range of uses to which computers can be put in the classroom.

Princeton University Professor Michael S. Mahoney introduced us to the world of LOGO and provided thorough critiques of our drafts of this paper. The final version reflects his good counsel. His assistance is greatly appreciated.

Finally, David Aiken took on the important task of editing this paper. Mary Capouya assisted in this area, and Carol O'Leary

capably saw the manuscript through the word processor many times as we worked toward its final form.

Stuart Senator
Frank Trinity
Richard W. Roper

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Major Findings and Recommendations

General

- Although most school officials believe that classroom use of computers should be encouraged, empirical research on the benefits of computer education is not definitive. There is evidence that the teaching of basic mathematics and reading skills, often aided by drill and practice and other techniques of rote learning, may benefit from computer-assisted instruction.
- The concept of computer literacy is not yet well defined, and the ways computers are used in schools vary. Operational definitions range from brief introductions to and simple familiarity with the technology to computer programming.
- Computer technology changes rapidly in complexity and capacity. Schools with computer education programs face the difficult task of keeping abreast of hardware and software developments.
- Teacher training is an important element in the development of computer education programs. The training must be directed at in-service teachers as well as college students preparing for teaching careers.
- School officials should have a clear educational purpose in mind before proceeding to integrate computers into the school curriculum. Careful planning focused on the educational goals to be achieved should precede the purchase of computer hardware and software.

New Jersey Case Studies

- New Jersey school districts, large and small, rich and poor, are installing computers in the classroom and establishing programs in computer education.
- Wealthier school districts in the state outstrip poor districts in all aspects of instructional use of computers. Wealthier districts have a much higher ratio of computers-to-students, more years of classroom experience with the technology, and a higher percentage of computer-trained staff.
- In our case study sites, Newark, Hunterdon, Ridgewood, and the Montclair-Kimberly Academy, computer use in the classroom is evolving in different ways and at markedly different rates.
- All of the schools we visited rely on in-service teacher training and offer incentives for teacher participation including graduate credit, salary increases, tuition refunds, release time, and computer loan-out programs.
- The case study sites have spent, on average, $100,000 per year to purchase computer equipment. Expenditures per pupil varied, however. These variations were most striking in Ridgewood, which has 5,100 students and a 1983 budget of $132,000 for computer education programs, and Newark, with 58,000 students and annual expenditures in 1983 of $120,000 on these programs.
- Although regional service organizations like the Wayne Computing Consortium and the Network for Action in Microcomputer Education serve as valuable forums for educators to exchange information on the use of computer technology in the classroom, few of the state's schools belong to these organizations. In addition, the state education department has not attempted to foster communication and cooperation among school districts. Consequently, information at the local district level regarding developments in computer technology and how other schools are using computers to meet curriculum objectives is seriously lacking.

Advances in Selected States

- Successful statewide programs of classroom use of computers have been established in several states, including California, Florida, Minnesota, and New York.

- The manner in which computer education programs developed in these states is similar. Local school leaders and teachers spearheaded early program initiatives, and over time state government leaders became actively involved. State-level interest and involvement assisted in promoting program planning, information sharing, and resource equity.
- These states usually increased their involvement by designating full-time staff at the state level to monitor developments in computer technology, survey the experiences of local districts, facilitate information sharing, and assist in hardware and software evaluation.
- In addition, these states made funds available to help local districts purchase computer hardware and software and to train teachers and staff in effective use of the technology.

State-Level Involvement in New Jersey

- Through the Educational Improvement Centers (EICs), the New Jersey Department of Education provided technical assistance to local school districts working to establish computer education programs.
- Technical assistance to local school districts is now being provided by Regional Curriculum Service Units, which are smaller in staff and budget size.
- The Governor of New Jersey has expressed interest in promoting the classroom use of computers and has made proposals to advance such use. His proposals have focused on upgrading computer education at the college level and less so on the elementary and secondary school level. New proposals to be announced in the Governor's 1984-85 budget message, however, may give more attention to computer use at the elementary and secondary level.
- Overall, state education leaders in New Jersey have not yet begun to play active roles in the evolving area of classroom use of computers.

Recommendations

1. New Jersey should establish a "Technology Equity School Fund" in the amount of $15 million to be distributed over five years to the state's poorer districts to help ensure that these districts have resources to develop computer literacy programs for their students.

2. The New Jersey Department of Education should play a more active role in support of all local school districts' efforts to develop computer literacy programs.

3. New Jersey should establish an information clearinghouse to which teachers can turn for assistance in the evaluation of computer hardware and software.

4. Local school districts should provide in-service training for teachers in the educational uses of computers. This training should be encouraged and supported at the state government level.

5. The state education department should expand its role in facilitating private-sector involvement in support of computer education programs in New Jersey's elementary and secondary schools.

1. Introduction

The use of computers in schools has become a major issue in American education in recent years. Far more than just a means of teaching mathematics, science, English, or other subjects, computers are increasingly important as a subject of instruction in themselves.

In its April 1983 report entitled "A Nation at Risk: The Imperative for Educational Reform," the National Commission on Excellence in Education urged that "all students seeking a high school diploma be required to lay the foundations in the Five New Basics": English, mathematics, science, social studies, and computer science.

The commission stated in its report,

> The teaching of computer science in high school should equip graduates to: (a) understand the computer as an information, computation, and communication device; (b) use the computer in the study of the other basics and for personal and work-related purposes; and (c) understand the world of computers, electronics, and related technologies.

Benjamin Compaine of Harvard's Information Resources Policy Program has been quoted as saying:

> This country is on the verge of an era in which the ability to read and write may not be sufficient to define what it is to be literate. Literacy may soon mean being able to access, manipulate and store information on a computer. The realization is growing that the edge in this emerging society will go to those willing to struggle with the new technology and continue the learning process well into mid-life and even later.

The question of whether schools are preparing students for "computer literacy" is an important aspect of a larger issue: whether elementary and secondary schools are responding to recent changes in the types of skills needed for work and for col-

lege study. This issue has been the focus of a series of discussions held by Princeton University's Council on New Jersey Affairs. The Council heard presentations by New Jersey's Chancellor of Higher Education, T. Edward Hollander; the Executive Director of the Governor's Commission on Science and Technology, Edward Cohen; and the President of Educational Testing Service, Gregory Anrig, along with two members of his staff, Marjorie Ragosta and Martin Schneiderman. The Council concluded that one useful indicator of how well schools in our state are upgrading their education programs might be the extent to which this "Fifth Basic"—computer literacy—is being integrated into school curricula.

As work on this project progressed, it became clear that the new technology being introduced in the classroom today is having a much more profound effect on education than the television, video cassette, and teaching machine of the 1960s, which were heralded as such effective tools in educating children. The computer has emerged as a major force in our schools. Parents want their children exposed to this technology. Once exposed, children are eager to maintain and upgrade their use of the machines, and teachers are being forced to equip themselves with computer skills in order to keep abreast of their inquiring students' interests.

The growth of interest in computers and their applications in modern life is obvious. What is less well understood is how schools are at present actually using computers and incorporating the technology into their curricula. This working paper is a first attempt to assess what local school districts in New Jersey are doing in this area. Section 2 explains several important issues and concepts, related to computer use in the schools, which are frequently mentioned in the text. Section 3 describes the educational uses of computers in New Jersey school districts, drawing on a survey of all districts and on interviews in selected districts. Section 4 provides an overview of what is occurring in this area of education in several states that are regarded by knowledgeable individuals as leaders in the use of computers in schools. Section 5 describes the extent of New Jersey State government involvement and leadership in this area of education. The sixth section contains conclusions and an elaboration of the policy recommendations we propose.

2. Issues Related to Computer Use in Schools

Across America, school districts are rushing to acquire computers. In the rush, there is the danger that school officials will buy hardware and hire staff without carefully defining exactly which educational goals they want to reach with the use of computers, and how they want to reach them.

Most school systems incorporate computer literacy as a component of their curriculum, because they believe that students will need computer-related skills in workplaces that are already being reshaped by the rapid advances in this technology. Many educators believe the value of computer instruction lies not so much in the technology's enhancement of the acquisition of knowledge but in its ability to equip students with a skill necessary for a productive life.

Yet computers can have a number of uses in schools. There are three levels of computer use in the classroom. The two most common uses are for drill and practice and for programming. The third use, which is less frequent but potentially the most powerful, is in helping students learn concepts in all subject areas. While programming teaches *about* computers, the other two uses teach *with* computers.

Drill and practice is the most rudimentary use of computers. The computer presents students with programmed questions and tells the students whether their responses are right or wrong. This type of instruction helps reinforce students' knowledge of simple concepts and is useful where rote learning is needed. Examples include helping students memorize multiplication tables, remember the names of state capitals, and recall vocabulary in foreign language courses. Drill and practice requires, and therefore teaches, precision.

Drill and practice can be especially useful for physically handicapped students who are unable to use pencil and paper easily but can more readily use a keyboard. It is also widely used for remedial work.

Programming teaches how the computer works. It involves the student in directing the computer's activities. By typing instructions, the student tells the computer what to do with the information it has been given. Programming not only challenges students to think in a new way about how to solve problems, but also teaches the importance of breaking large problems into manageable components. It can be applied to problems in such disciplines as logic, calculus, geometry, and economics.

Although drill and practice and programming are the most common uses of the computer in classrooms, advances in computer technology are allowing much broader uses in many areas of the curriculum. Computers have for several years been widely used in teaching mathematics, where problem-solving skills can be taught in much the same way that programming is taught. But in recent years computer teaching programs have become available in a wide range of subject areas.

Another value of the computer is enabling students to perform simulations, in effect conducting experiments and asking "what if." For example, one currently available program for students at the elementary level allows children to simulate construction of electrical circuits to create various mechanisms. On the secondary level, some experiments in biology, chemistry, and physics can be done by means of computers rather than in laboratories.

Computers can assist learning in many other ways. Word-processing facilities, for example, can help students learn English skills. Several computer programs include built-in dictionaries to check the spelling of several thousand common words. Teachers of geography courses can have students use programs that develop map-reading and calculation skills by "navigating" a simulated ship to a new continent and returning safely. Schools have used computers in such widely varied areas as history, music, and art.

Many educators believe that schools should not only teach with computers and teach how to use computers, but should also help make students aware of the effects of computers on daily life and work. This "computer awareness" involves some discussion of the role of computers in the economy and in society, as well as the ethical and social issues related to computers' widespread uses and potential abuses.

Because there are different levels of computer use in schools, there are also different views on what constitutes "computer literacy." Some experts define it as knowledge of what a computer can and cannot do; others say it is the ability to develop complex programs; still others suggest that it can be defined as skills that fall in between these two extremes. The dominant view changes with each advance in technology. For our purposes here, the term "computer literacy" is used to mean familiarity with the capabilities and limitations of computers, awareness of the social issues raised by the computer's widespread use, the ability to use professionally developed software, and a sense of what programs are and how they are put together.

Beyond the basic question of how the computer is to fit into the curriculum, educators must deal with a number of particular issues in designing courses about computers or integrating the computer into other courses.

The most crucial matter is that of staffing. This involves both finding a staff member to coordinate the school system's use of computers and training classroom teachers in ways to use computers. Schools can run into a number of problems related to staffing. One is that staff members who are competent and knowledgeable may be hard to keep; many are lured from schools into well-paying jobs in private industry. School systems can sometimes alleviate this problem by making cooperative arrangements with private firms to lend schools the services of some of their staff.

A second problem related to staffing is providing the right type of training to classroom teachers. Many teachers mistakenly believe that computer-related training requires a background in mathematics, and they are likely to be put off by training that heavily emphasizes the technical aspects of computer programming. Such training is usually unnecessary in any case; classroom teachers need to know how to operate computers and how to use them in their teaching, but can leave most technical aspects to the computer coordinator.

One issue that comes up in planning courses in programming has to do with the choice of the "language" to be used. Instruction in programming involves use of computer "languages," which are sets of commands or "words" understood by the computer as instructions to perform various functions. Different languages have different qualities that make them more or less easy to learn, more or less powerful for particular types of applications, more or less suitable for teaching the kind of logical thinking required in

programming, and more or less usable on the computers that most schools own.

Three languages are commonly used in elementary and secondary school classrooms. One is LOGO, which is quite powerful yet simple to use and allows young children to become familiar with the logic of computer operation. It is often used to construct graphics, and is widely found at the elementary level.

A second language, BASIC, is the most commonly used "higher-level" computer language. (A "higher-level" computer language is similar in its vocabulary to human languages. BASIC, for example, uses simple English words as commands.) BASIC is easy to learn, but it is awkward to use for advanced programming tasks. BASIC is found in many variations, each designed to fit a particular computer or to overcome a particular set of limitations of "standard" BASIC. It is widely used in programming at the secondary school level.

A third language used in schools is PASCAL, though it is less commonly found than LOGO or BASIC. PASCAL is the language used in the advanced placement course offered by a number of high schools, for which many colleges grant credit. Other languages that are widely used in college and graduate-level work, such as FORTRAN and COBOL, are occasionally found in secondary-level courses.

A second issue arises in planning ways to integrate computers into existing course areas. This is the problem of purchasing or developing appropriate software. "Software" is the program or information that is fed into the computer, telling the machine how to manipulate the data supplied to it. A cassette that tells a computer how to play "Pacman" is a simple example of software.

Hundreds of software packages designed for use in schools are available commercially, and hundreds more come on the market every year. Educators must be careful to choose software that is appropriate to the intended use. School systems that have staff with programming skills sometimes prefer to develop their own software. Some programs available from outside are in the public domain and can be readily duplicated and adapted without infringing on copyrights; other outside programs, however, are protected by copyright.

A final issue that educators must deal with is the choice of hardware—that is, the machine that runs the programs. Hardware includes the keyboards, screens, printers, data storage systems, and other equipment, as well as the unit that actually manipulates

the information and ties all of the other equipment together.

The basic choice is among a "mainframe" computer, a "minicomputer," or a "microcomputer." The primary differences among the three are the speed at which they operate and the amount of information they can store. A mainframe is a very large, powerful, and expensive computer, made up of many physically separate components. Because such a computer performs millions of operations each second, hundreds of users can hook their terminals into the system and use it simultaneously. Each user has the impression that he or she is the only one on the system, while in reality the computer is switching from one user to another.

A microcomputer is the smallest type of computer. This is the "personal computer" that has become widely available in the last few years. It is built around a "microprocessor," which consists of chips that contain all of the arithmetic and logic functions, command-decoding capabilities, and program registers needed to perform computer functions. A microcomputer typically consists of a television screen and keyboard, with the microprocessor units built in and data storage units either built in or easily attachable.

Midway between the mainframe and the microcomputer is the "minicomputer." Minicomputers typically have a separate central processing and data storage unit (CPU). People at several terminals can use the system simultaneously, but the number of users is usually less than a hundred—far fewer than can use a mainframe computer simultaneously.

Minicomputers were the primary type of hardware available to school systems in the early 1970s, when a number of them first began to use computers in the classroom. Microcomputers are more flexible than minicomputers for many purposes. Each microcomputer in a school can run a different program, while a minicomputer is limited in the number of different things it can do for different users at the same time. Minicomputers do, however, allow a teacher to monitor several students' progress at different terminals hooked up to the same system.

Although the choice of a type of hardware and the further choice of a particular make and model of computer are important decisions, they are not so basic as the decision as to how computers in general are to fit into the curriculum. Choosing hardware before confronting this more basic decision is an easy mistake for a school system to make.

3. Computers in New Jersey Classrooms

New Jersey schools have approached the use of computers in different ways and with different results. Some districts have more expertise and experience than others, and different districts have taken different approaches to the issues discussed in the previous chapter.

Results of both a mail survey conducted by the New Jersey Department of Education and interviews conducted in four selected school systems by the Council on New Jersey Affairs show that great disparities in the extent of computer use exist between relatively affluent school districts and relatively poor districts, both urban and rural. The wealthier districts began to use computers much earlier and have acquired more hardware than districts with limited fiscal capacity.

Survey Findings

The New Jersey Department of Education sent survey questionnaires to 591 school districts in October and November 1983, and received responses from 397 of them. Of the districts responding, more than seven out of ten (71 percent) had developed and implemented a curriculum plan related to instructional uses of computers, and almost all of the remaining districts were considering a plan for the next school year. The department of education broke down the survey results into ten groups of approximately fifty school districts each on the basis of socioeconomic characteristics. Of the thirty-nine districts in the poorest category, 38 percent had not developed a curriculum plan for computer use, compared with less than 6 percent of the thirty-three districts in the wealthiest category. (It should be noted that

Table 1. *Number of Years Districts Have Used Computers*

Years of use	Percentage of change		
	All (*N*=397)	*Poorest* (*N*=39)	*Wealthiest* (*N*=33)
1	22.4	33.3	11.8
2	23.4	23.1	23.5
3	14.7	10.3	17.6
4-9	18.8	17.9	23.5
10 or more	15.2	12.8	23.5

Source: New Jersey Department of Education survey data.

Note: Figures in columns do not always add to 100 percent because some respondents reported they had used computers for "zero" years, apparently in error.

the questionnaire did not define what constituted a "curriculum plan," so it is not known how many districts have detailed plans and how many merely include brief statements on computer use as part of overall curriculum outlines.)

Of the districts using computers, 60 percent had been doing so for three years or less: 22 percent for just one year, 23 percent for two years, and 15 percent for three years (see table 1). Another 19 percent had been using computers for from four through nine years, and 15 percent for ten years or more. As table 1 shows, significantly higher percentages of districts in the wealthiest category had used computers for four or more years, while smaller percentages of those in the poorest category had such long experience.

Wealthier districts are also likely to have larger numbers of computer workstations, i.e., microcomputers and terminals hooked into minicomputer or mainframe systems. Almost 60 percent of the wealthiest districts reported having twenty or more microcomputers, compared with 42 percent of the poorest districts. The figures were similar for numbers of terminals connected to minicomputers or mainframes. *In the wealthiest districts, the ratio of computer workstations-to-students is 1 to 49.4, and in the poorest districts, the ratio is 1 computer workstation to 79.6 students.*

The level of staff training in computer use is also greater in wealthier districts than in poorer ones. More than 80 percent of the teachers and administrators had participated in computer literacy or computer awareness training in 48 percent of the wealthiest districts, while only 13 percent of the poorest districts had reached that level. As table 2 shows, most poor districts are just beginning to introduce their staffs to instructional uses of computers.

Table 2. *Percentage of Teachers, Administrators Receiving Computer Training*

Percentage trained	*Wealthiest districts*	*Poorest districts*
1-20	9.0	36.8
21-40	18.1	21.0
41-60	6.0	10.5
61-80	18.1	18.4
81-100	48.4	13.1

Source: New Jersey Department of Education survey data.

The survey results showed little difference by level of wealth in the uses to which computers are put. (This finding may result, in large measure, from the type of response requested by the survey instrument.) Most districts that had computers used them both for self-contained courses on computers and as tools in other subject areas. (The questionnaire did not differentiate between uses for drill and practice and other uses such as gaming and simulations.) The survey also found that most school districts (three out of four) placed at least some of their microcomputers or terminals in classrooms, while smaller numbers had some in special computer labs (two out of three), library learning centers (two out of five), or media centers (one out of five).

Interview Findings

The finding of disparities between wealthy and less well-off districts in the survey data is consistent with what we found in our observations in four selected districts in the state. In selecting school districts for this study, we looked for schools that (1) were using the computer in interesting and innovative ways and (2) were in different regions and had diverse socioeconomic characteristics. With advice from the New Jersey Department of Education and Educational Testing Service, we chose to visit Hunterdon, Newark, and Ridgewood as well as the Montclair-Kimberly Academy. Hunterdon is a rural district, Newark an urban district, and Ridgewood a suburban district. Montclair-Kimberly Academy is a private college preparatory school. To ensure a variety of perspectives, we talked with different officials in each district. In Newark we spoke with district officials, in Ridgewood and Hunterdon Central we saw high school administrators, and at

Montclair-Kimberly we spoke to the middle school computer coordinator.

While all of the selected school districts share a commitment to meeting the changing needs of their students, each chose a different means to this end. This section examines how computer education evolved and is evolving in each district. Two locally based organizations, the Wayne Computing Consortium and the Network for Action in Microcomputer Education (NAME), which seek to promote computers as effective tools in education, are described briefly.

Hunterdon Central Regional High School

Initial Steps. Hunterdon Central High School draws students from five Hunterdon County municipalities—Flemington, Readington, Raritan, East Amwell, and Delaware. The district is rural and has a very low minority population. In the 1982-83 school year, Hunterdon Central had an enrollment of 2,206 students; 66 percent of Hunterdon Central students normally go on to college. The high school has a mainframe computer, acquired in 1973 for instructional purposes but now used for general administrative applications, including use of the guidance information system. In October 1980, the board of education set aside $40,000 to fund an initial purchase of microcomputers. The school now has approximately fifty microcomputers for student use. In the 1982-83 school year, about 350 of the school's 2,206 students actually used a computer.

The central figure in the computer program at Hunterdon Central is the assistant principal for instruction. He is the school's local resource person; any teacher considering using computers in a class comes to him for advice, although each department makes its own final decisions. Most software is commercially produced, but some is the product of in-house development by the assistant principal for instruction.

Local Policy. Hunterdon Central lacks a systematic educational plan for computer use. The district's goal is to maintain its leading position among Hunterdon County schools. The district does not have a working definition of computer literacy. Since an opportunity to use a computer is often regarded by students as a privilege, many teachers use the computer as a reward mechanism.

The Computer as a Component of the Curriculum. The school's microcomputers are used for programming, word processing, computer-assisted drafting, physics simulations, health occupations, special education, and general use in the library. BASIC and COBOL are taught in programming classes. These classes are open to all students without prerequisites, despite complaints by some teachers who want to track computer classes. Mathematics and science teachers are exploring additional computer applications in their courses.

For the past two years, teacher training has been conducted by the assistant principal for instruction in afternoon courses. Some of these classes have carried credit for graduate work at Trenton State College. About ninety teachers have taken the afternoon classes. Many teachers have also taken advantage of the local Radio Shack's free computer courses for teachers. All fee courses teachers take are paid for by the school, and the courses taken for credit may advance teachers on the salary scale. This is the school policy for all teacher training programs, not only computer education.

Costs. Hunterdon Central High School has spent approximately $75,000 on its microcomputer program since it began in 1980. In 1982-83, the school spent only about $4,000 on the program, although in 1983-84 it is spending $75,000 on a computer-assisted drawing system for its drafting program.

Newark

Initial Steps. With a 1980 population of 329,248, Newark is New Jersey's largest city. The median household income is $10,118. Newark's school system consists of 58,000 students and 8,000 teachers in 80 schools. Newark's secondary schools have an enrollment of approximately 14,000 students. Forty-four percent of the district's 1982 graduates went on to college. Computers were introduced into Newark's classrooms in 1972, when the district began a remedial education program in mathematics and science using drill and practice on a mainframe computer.

In 1976, the district acquired a Hewlett-Packard minicomputer to expand the drill and practice program. Now drill and practice is used in twelve schools, including four secondary schools. In three secondary schools, drill and practice is used for remediation in mathematics and reading. In the fourth secondary school, drill and practice is used in ninth-grade bilingual education to improve reading skills in the context of mathematics and English lessons.

This program is funded by title VII federal grants. Buying software from the California Curriculum Corporation, the district developed a bilingual education curriculum. Terminals were placed in high schools to teach BASIC programming. The minicomputer was also used for administrative purposes, such as providing guidance information. In August 1983, there was a total of seventy-five PET Commodore microcomputers in Newark's ten high schools.

Local Policy. Last year, the Newark Board of Education passed a resolution expressing its commitment to graduating computer literate students. Newark's definition of computer literate students is having an awareness of how computers work and how computers affect society, as well as possessing programming skills.

In Newark's original microcomputer purchase, district officials believe they had unwisely bypassed three important steps:

1. Starting a teacher training program
2. Setting up a mechanism for software review
3. Planning for maintenance.

Microcomputers are a recent phenomenon, and most teachers—even those with a computer science background—must themselves learn how to use the micro before they can develop any educational applications. Software acquisition also presents a stumbling block; the educational market is relatively new, and a great deal of software is poorly written. Finally, when a computer breaks down, there must be a way to have it fixed or replaced immediately; otherwise, lessons are disrupted.

In order to prevent the district from repeating its mistakes, the superintendent of schools decided that an educational plan should be developed before computers are purchased. The position of district coordinator of computer instruction was created so that there would be one person to review all district plans to use microcomputers. A Newark Spanish and bilingual education teacher who had worked with computers in the bilingual education program was hired to fill the position. The process by which computers are placed in the classroom now consists of several steps. It begins with the submission of an educational plan to the computer instruction coordinator and to the board of education's instructional committee for approval. Next, a teacher training program is developed. Teachers then work with the coordinator and the curriculum department in the selection of software. Finally, the district's executive director of management information, who has a degree in computer science and formerly worked in data

processing, decides which hardware to buy. Most teachers would prefer to choose their own hardware, but the hardware coordinator estimates he spends eight hours per week just keeping up with the new technology and he believes that his expertise has kept Newark's program running smoothly.

Computers as a Component of the Curriculum. In the elementary schools, computers are used for simulations and word processing, in addition to programming in LOGO and drill and practice. For example, a student may use a popular program called "Lemonade Stand," which simulates operating a business. The student makes decisions based on inventory, capital, weather, etc., and the computer shows what profits will be generated.

A typical drill and practice session in a Newark elementary school includes two ten-minute periods in front of a terminal, one concentrating on reading and one concentrating on math. Half of the questions that the computer generates are at the student's grade level, 25 percent are at a higher level, and 25 percent are at a lower level (for reinforcement). Drill and practice is also used to generate homework problems.

Programming dominates the Newark secondary school computer curriculum. East Side, West Side, Weequahic, and Science high schools were noted for their early progress in both drill and practice and programming. The six high schools that do not offer drill and practice *do* offer programming instruction on the PET Commodore. In the 1982-83 school year, three out of the ten high schools taught word processing on a limited basis. In September 1983, Newark began to offer word processing to all secretarial students. The computer will also be used in two algebra classes.

Due to budget constraints, the Newark program remains on an extremely small scale relative to the size of the district. Most Newark students never use a computer. In 1982-83, fewer than 1 percent of the district's students used the machines.

Newark officials have designed a new systemwide curriculum focused on teaching programming skills. LOGO will be used in grades kindergarten through five, BASIC in grades six through nine, and FORTRAN, COBOL, and PASCAL in grades ten through twelve. Officials expected to have implemented this plan up through grade nine by October 1983. They also expect that by September 1984 all business departments will be offering instruction in word processing and that programming will have been expanded to include FORTRAN, COBOL, and PASCAL. But the Newark school program will still be providing fewer than 2 per-

cent of the district's students with time on the computer.

During the summer of 1983, Newark moved some drill and practice into its federally funded title 1 summer camps. Students, in grades three through twelve, worked on mathematics and reading at sixteen terminals for forty minutes a day. Regular computer-generated progress reports assisted teachers and motivated students. Also, the district initiated Saturday computer programming classes. These were open to selected teachers, parents, and students. Student participants, recommended by their school principals, included fifty high school pupils and a smaller number of junior high and elementary school students.

Teacher Training. When Newark purchased its first lot of microcomputers, it had no teacher training program in place and only a few teachers sought out classes independently. In the fall of 1983, Newark initiated a districtwide training program for teachers of programming classes, based on an in-service course outline developed by two computer science teachers. Teacher training in the use of drill and practice takes place throughout the year, but is allotted only a small amount of time. Training typically involves three full-day sessions dealing with introduction to computers, curricular applications of drill and practice, and interpreting computer-generated reports on student progress. Consultants from software companies run the drill and practice training. Teacher training on a wide scale, however, is just getting off the ground.

Upon completion of training, teachers receive in-service credit that lets them move up on the salary scale. If they take courses at universities, they receive graduate credit. Newark does not offer tuition refunds.

Costs. During the 1982-83 school year, Newark spent $50,000 on computer-related equipment. This year, the district plans to spend $120,000, most of it on hardware, but some funds will be allotted to teacher training and software.

Ridgewood

Initial Stages. The Village of Ridgewood, located in Bergen County, has a population of 25,208. The 1979 median income of Ridgewood households was $34,494. Ridgewood has one high school, two junior high schools, and seven elementary schools. The district enrollment is approximately 5,100. The high school has an enrollment of 1,300 students, 85 percent of whom normally go on to college. Ridgewood started to use computers seventeen

years ago, and now the computer is used in many subject areas.

The high school has a ten-year-old PDP 11/40 minicomputer, which will have twenty-three terminals this fall. Ridgewood High has a micro-room with eighteen Commodore 64s. There are also several microcomputers in a project room, which houses many of the minicomputer terminals. By September 1983, each of the two junior high schools had over thirty microcomputers or terminals. In the seven elementary schools there were fifty-five microcomputers as of May 1983. This number was to have been substantially increased in the fall of 1983. In 1982-83, the ratio of computers to students in Ridgewood varied from 60 to 1 to 20 to 1, depending on the school. In 1983-84 the district hopes to have this ratio at 20 to 1 uniformly.

Local Policy. Four years ago, the Ridgewood Board of Education mandated that students be computer literate by seventh grade. The high school coordinator defined computer literacy on three levels: (1) awareness; (2) application of prepackaged programs; and (3) programming skills. The district has two coordinators of computer education, one for kindergarten through ninth grade and one for grades ten through twelve. Both have graduate degrees in mathematics. The kindergarten-through-nine coordinator is pursuing a doctorate in education administration. The ten-through-twelve coordinator has had extensive computer training in IBM and GE programs, and has attended five National Science Foundation summer sessions. She is working on a doctorate in mathematics and computer education.

The Computer as a Component of the Curriculum. Computers are used extensively at the elementary school level. In addition to using computers with LOGO and word processing in a required introductory course, students use the machines to reinforce learning skills with drill and practice programs. In junior high school, students may take BASIC I and II as electives.

In the high school, the graphic arts and television studios both have a microcomputer. Two Commodore PETs are used for word processing in English and three micros are used in foreign language study. Ridgewood's foreign language teachers developed their own drill and practice software, which they have been using for the past two years. In business education, four Apple 2Es are used to teach vocational word processing with the WORDSTAR software package. The Typing II course includes modules on word processing, VISICALC (an electronic spreadsheet), and elementary programming. In science and social studies, the computer is

used for simulations. In economics, it is used to test out economic models and demonstrate the effects of changes in some of their variables. Three Commodore PETs are used in special education.

In the high school, approximately 500 students enroll in computer science courses each semester. These classes consist of three lab days and two theory days, thus opening up the computer room two days per week for use in other subjects.

Ridgewood is comparatively self-sufficient. Most of the software used is the product of in-house development, an anomaly among the districts the Council's researchers visited. Ridgewood receives additional software from the Minnesota Educational Computing Consortium (MECC) through the Wayne Consortium as well as from commercial producers.

Teacher Training. Most in-service training is also self-contained. Ridgewood belongs to a group of five schools that conducts joint training programs. Some teachers attend adult school and receive up to 90 percent tuition refunds. They are also given release time, which, the high school computer coordinator says, is as important as money. The board of education's recent decision that all students should be computer literate has spurred teachers to enroll in training programs. Ridgewood teachers also have the opportunity to sign out a microcomputer or take home a computer terminal and dial up the minicomputer for home training. Hence, 85 percent of Ridgewood's teachers have been exposed to computers.

Costs. In the last two years, Ridgewood has spent approximately $200,000 for instructional computers. For 1983-84, the board has budgeted another $100,000 for new hardware, in addition to the approximately $32,000 yearly budget for computers. Commercial software for microcomputers has been very expensive because a new copy of a program must be purchased for each machine, and some software is too complex for anyone but a group of full-time programmers to develop. The PASCAL program, for example, took computer specialists hundreds of work hours to develop and sells for $200 per machine. It cannot be duplicated under the copyright laws. Consequently, Ridgewood was able to buy only a limited number of programs. The school's minicomputer is less expensive than the microcomputers in this instance because one program can be used by all of its twenty-three possible users.

Montclair-Kimberly Academy

Initial Stages. Montclair-Kimberly Academy is a private school with a total enrollment of 1,050 students. The school is divided according to grade level into three campuses in Montclair: a kindergarten through fourth grade elementary school, a fifth through eighth grade middle school, and a four-year high school. Tuition ranges from $3,100 for kindergarten to $5,300 for twelfth grade. In 1979, Montclair-Kimberly decided to integrate computers into all areas of its curriculum. Three teachers took a summer course in BASIC at the Taft School in Connecticut, and in the fall, the board of trustees adopted a curriculum proposal that required the immediate purchase of six microcomputers.

Administrators and teachers showed interest in computers early, a key to the school's widespread use of computers today, according to the middle school computer coordinator. Montclair-Kimberly received a $40,000 grant from the Rockefeller-Dodge Foundation to pay for teacher training and the development and evaluation of educational software. The school agreed to conduct summer training sessions open to teachers in other schools as part of the grant's terms. It also received a smaller grant from the Charles Merrill Foundation specifically for teacher education. The following summer, Montclair-Kimberly sent ten teachers to the Taft School to prepare them to train other teachers.

Local Policy. Montclair-Kimberly Academy's policy on computers is to explore their various applications, to find their most creative and interesting uses, and to make students feel at ease with the computer.

Teacher Training. For the past two years, Montclair-Kimberly has conducted a summer computer institute for teachers, run by teachers with student aides. The institute has received wide attention and now serves teachers from several northeastern states. Revenues generated from the institute help finance computer training at the school. The program offers three courses: (1) computer literacy, including the educational applications of computers; (2) BASIC programming; and (3) advanced BASIC. Teachers learn to write their own software in both programming classes. Participants include elementary, secondary, and college teachers, from Montclair-Kimberly Academy, other New Jersey schools, and schools in nearby states. The participants receive three graduate credits from Montclair State College. A two-week course costs $400, and this fee is usually paid by the participants' employing

districts. The computer institute trains about a hundred teachers per summer. Montclair-Kimberly teachers attend the institute at no cost but receive no graduate credit.

More than 50 percent of Montclair-Kimberly's teachers have computer training. Its department chairpersons are now being trained to evaluate software.

The Computer as a Component of the Curriculum. Computer instruction in the elementary school is less formal than in the middle school and the high school. Students use the computers periodically in their regular classes, rather than take courses solely on computers. They use KIDSTUFF, an elementary language similar to LOGO, to reinforce concepts of geometry and mathematics. Computers are also used to challenge advanced students.

The middle school has 384 students and 40 teachers. The school has two computer rooms with ten computers in each and another room with four word-processing machines. All middle school students use computers. The middle school computer science department *requires* the following courses for fifth through seventh grade students:

> Grades five and six—Introduction to LOGO through Turtle Graphics.
>
> Grade seven—Computer literacy in BASIC programming.

Courses are one trimester long and meet for two or three forty-five-minute sessions per week. The seventh grade course combines a structured programming approach to BASIC with discussion of the social issues of computers.

In grades eight through twelve, the following computer courses are offered as electives: Basic I, Basic II, Data Structures (advanced programming and systems design), and PASCAL (which prepares students for the College Board advanced placement exam).

Word processing is growing in popularity among teachers and students at Montclair-Kimberly Academy. All seventh graders must take a course in the mechanics of word processing. In subsequent years, word processing is used in English classes. The school newspaper is printed by means of a word processor. Computers are used in remedial mathematics and in language arts; the music program includes a three-week unit on tone recognition with the aid of computers. Computer simulation is also used to teach geography, and computers are used to help identify rock types in earth science.

The software used in science classes was written by an MKA

science teacher. Montclair-Kimberly receives a great deal of Minnesota Educational Computing Consortium (MECC) software through the Wayne Consortium. This arrangement allows the school to make unlimited copies for its own use.

Interdistrict Cooperation

Many local districts have started to band together to share information and expertise and to reduce costs associated with computer use in their schools. The organizations they have formed are the first regional groups in the state dedicated to the educational uses of computers, and many of the experts and innovators in this field are associated with these groups.

The Wayne Computing Consortium

Initial Steps. In 1970 the Wayne School District acquired a Hewlett-Packard minicomputer. By the end of the decade, Wayne had formed a consortium of computer-using school districts and had become the center of a time-sharing network of several hundred terminals, located in schools from about fifty districts in northeastern New Jersey. With the advent of inexpensive microcomputers and the lessening emphasis on minicomputers, Wayne changed its emphasis to microcomputer services. In the late 1970s, Wayne joined MECC, which was also reducing its use of a time-sharing system.

Services. The Wayne Consortium, also called the Wayne Co-op, is committed to facilitating interdistrict activities in computer education. As one of MECC's New Jersey institutional representatives, the consortium distributes MECC, public domain. and other licensed software to its members for an annual fee of $300. The revenues received are channeled back into the co-op's activities; thus, a nonprofit status is maintained. At the end of the 1982-83 school year, the co-op had a membership of approximately 130 districts, 100 of which were using Wayne's microcomputer resources.

The consortium offers joint purchasing services. Currently, co-op members are able to buy Apple computers at a 27 percent discount and Commodore products at a 25 percent discount. The co-op buys materials such as diskettes, paper, and ribbons in quantity and resells them to its members at discount prices. The consortium plans to increase the number of agreements it has with vendors of commercial software and it also plans to convert soft-

ware to be compatible with different models of computers.

The co-op plans to move into equipment maintenance, setting up regional centers that would repair faulty equipment on-site or issue loaner equipment to the user. It also hopes to serve as a clearinghouse for interdistrict resale of computer equipment.

The Wayne Consortium has been involved in microcomputer teacher training. Since December 1981, it had been providing MECC software to the state's four regional Educational Improvement Centers (EICs). When the EICs closed, the co-op sent letters to all New Jersey school district superintendents in an unsuccessful effort to get them to hire the consultants previously employed by the EICs.

The Network for Action in Microcomputer Education (NAME)

In order to fill the gap left by the closing of the state's four regional centers, the Wayne co-op's director convened an independent advisory committee composed of teachers and administrators involved in the Wayne Consortium. It proposed to establish the Network for Action in Microcomputer Education (NAME), a regional cooperative activity devoted to teacher training. The Wayne Board of Education is providing funds to initiate the network and is assuming financial responsibility for the organization, with the expectation that Wayne will benefit from NAME's services and that NAME will generate sufficient revenues to cover expenses. It is the group's hope that NAME will eventually become a financially independent, nonprofit consortium of local school districts, an organization which would have the legal status of a Local Education Association (LEA) in New Jersey. The annual membership fee is $500. As of August, 1983, NAME had twenty-five member districts from throughout the state.

NAME plans to concentrate on three main areas of computer education:

- In-service education for teachers through workshops at regional sites.
- Negotiating group purchasing agreements for software and hardware.
- Sharing of information and resources.

The Wayne Consortium and NAME complement each other. The consortium concentrates on providing low-cost software while NAME primarily will offer teacher training programs.

NAME recently established an agreement with the Bank Street

College of Education in New York City for consultant services, jointly sponsored workshops, and cooperative research and product development. NAME would like to work with the New Jersey higher education community as well.

NAME has been working with the public television station WNET to develop a program to teach educators how to evaluate software. WNET plans to sponsor several conferences concentrating on software review techniques that have been used successfully across the country. The conferences will feature the executive director of the Long Island-based Educational Products Information Exchange (EPIE). Seminars will be targeted to administrators and teachers separately. NAME will conduct subsequent workshops on a regional basis and hopes to set up regional centers for computer education. NAME is also coordinating the creation of a data base of selected software reviews from national journals. There are no immediate plans to develop a staff of software evaluators.

Summary

At Montclair-Kimberly Academy and at Ridgewood schools, teachers and administrators have harnessed available resources and have set up coordinated and comprehensive computer education programs. These two schools have progressed in staff development and software evaluation almost to the point of self-sufficiency. At Hunterdon Central Regional High School and in the Newark schools, most teachers and students have not had the chance to use a computer on a regular basis.

Both Newark and Ridgewood have a district mandate to prepare computer literate graduates. The two school districts have progressed at vastly different rates in their efforts to bring that promise to actuality: The numbers speak for themselves. Ridgewood, with 5,100 students, has alloted $132,000 for its computer program in the 1983-84 school year. Newark, with a total enrollment of 58,000 students, plans to spend only $120,000. *Last year, every Ridgewood student had the opportunity to use a computer. During the same period, just 1 percent of Newark's students used a computer in school.*

Groups like the Wayne Computing Consortium and NAME provide a forum for educators to exchange information on successful computer programs. Districts just undertaking computer education programs have benefited greatly from the MECC materials offered by the Wayne Consortium, and its members expect similar

benefits from future staff development programs sponsored by NAME. These local groups address the need for information about the educational applications of computers, but the Wayne Computing Consortium and NAME do not have the resources to help school districts overcome the financial constraints that they face in undertaking computer education in their classrooms.

4. Successful Programs in Other States

California, Florida, Minnesota, and New York are four states advanced in the educational uses of computers. Each state is approaching the process of integrating computers into its public schools differently, according to its own needs and time frame. In each case, the state department of education has played an important role. This section contains a description of the approaches these states have taken to the educational uses of computers and the roles played by their education departments.

California

Before 1982, there was no state involvement in the educational uses of computers. In 1982, Governor Jerry Brown created the Investment in People program to improve the state's public schools. This funded fifteen regional Teacher Education and Computer (TEC) centers to facilitate the process of integrating computers into the state's public schools. Each was given the authority to allocate its budget to meet the region's needs.

The TEC center budgets are based solely on the number of students in their region. Budgets do not take into account the possibly greater needs of some areas, except that urban areas have larger budgets because they have more students. Budgets average about $250,000 per center. This money funds a director, a computer specialist (who runs training programs and helps evaluate software), purchase of equipment for a microcomputer lab, and stipends to teachers for training. The percentages of the TEC center budgets allocated to these activities vary. Some centers spent minimal amounts on equipment because hardware was already available at the facilities at which they were based. Vendors

started to donate equipment to some TEC centers so teachers could become familiar with their products. The TEC centers have small staffs because they do not actually conduct most of the teacher training; they just coordinate and oversee it. Staff members pick out key local personnel to teach workshops, find suitable locations, and publicize the programs. The staff provides limited consulting services to the districts, but identifies qualified private consultants for extensive district projects.

In late 1982, federal funds became available to the department of education under chapter 2 of the Education Consolidation and Improvement Act, which emphasizes computers in education. The department, through its regional training centers, implemented a plan to publish high-quality planning guides, develop statewide purchase agreements with computer companies, give internal training, and send out annual surveys to compile statewide figures on computer use.

Districts in different areas have been integrating computers into their schools at different paces. In technology-rich areas, such as Silicon Valley, companies are donating equipment, and the schools are forging ahead at a rapid pace. A few of these communities have even developed a comprehensive computer literacy curriculum.

The Cupertino Union School District in Silicon Valley is a kindergarten-through-eighth-grade district with a comprehensive computer curriculum. Eighty percent of Cupertino's teachers are computer literate, and *all* schoolchildren regularly use computers. Cupertino's definition of computer literacy is "the ability to function in a computer and technology oriented society.... understand computers and their applications and implications in the world around them.... develop the skills necessary to communicate with computers and recognize the computer's capabilities and limitations."

The district has its own staff development program, which allows district teachers to instruct each other. There is a full-time program director for staff development. Microcomputers are used throughout the traditional curriculum as well as in separate programming classes. There are eight computers in each elementary school and sixteen in each junior high. They are used for simulations, elementary education with LOGO, database and spreadsheet manipulation, and other creative uses, in addition to drill and practice and programming.

There is a program that does library record-keeping. Another

program teaches mathematical and statistical relationships with bar and pie graphs. A golf simulation teaches children geometry by having them estimate the distance and angle of a golf shot from tee to hole. Another program teaches logical and electronic concepts, introducing students to all of the circuits involved in the machinery of the computer. Students are given a model and opportunities to test hypotheses. They are taught how to build and test simple electronic machines.

The district's computer program started as an Elementary and Secondary Education Act (ESEA) title IV-C grant in the fall of 1978. More funding was provided under the federal ESEA title IV-B program. Staff development came under a title IV grant. Hardware was also purchased with capital improvement funds from the sale of recently closed schools. In the fall of 1981, the district included funding of computers in its operating budget.

The district has a centralized software inventory. Principals must get approval from the central coordinator before purchasing software. The software must correlate with objectives in the district curriculum in addition to being educationally sound. The district previews all software before purchase and serves as a test site for new commercial software. Software developers are willing to let Cupertino preview their merchandise, because the district has developed and publicized its stringent policy of obeying copyright laws.

In the fall of 1983, Cupertino offered nine computer education courses for teachers, ranging from a six-hour "Introduction to Computer Literacy" class to a sixteen-hour "LOGO for the Atari" course. All the courses were filled, although no salary increase or graduate credit was offered. In Cupertino, the average age of teachers is over fifty years, and most teachers are already at the top of the salary scale. Teachers receive credit toward conference expenses or time off to visit other schools. The Cupertino program is low-keyed, relaxed, and instruction is provided by local teachers. Most teachers stay after school one day each week to teach or take in-service courses, according to the district's curriculum coordinator. The program has boosted morale and enhanced the school's standing in the community.

In computer-using districts in California, one or two teachers have usually been the catalyst for the integration of computers into the curriculum. Where such teacher activism is lacking, not much progress is being made, according to department of education officials.

The new Superintendent of Public Education in California, William Honig, has placed a high priority on increasing the private sector's involvement in promoting the educational uses of computers. Many companies have expressed an interest in donating software and hardware to the schools but do not know how to go about doing so. Members of the state department of education are meeting with representatives of these firms to capture their interest and to direct their donations.

Schools may buy computers from a variety of funds, including federal grants, but they are not allowed by state law to use their capital budgets for this purpose. There is a way to get around this, however. If a district has no outstanding debts or deferred maintenance, it may petition a state board to let it divert capital funds into its operating budgets. This is how Cupertino was able to finance hardware purchases with money from the sale of schools that had been closed.

In 1983, Apple Computers donated one microcomputer to every school in the state. This program was the result of new state legislation that Apple promoted; companies receive a California income tax deduction for the value of the equipment they donate. The project has had spin-off effects. Dramatic discounts are now being offered by other hardware and software vendors who want to capture a share of the educational market. Hewlett-Packard and IBM have begun moderate-size donation programs in California.

In San Mateo, the County Office of Education set up the San Mateo Software Library and Clearinghouse, which coordinates the evaluation of software. This project is now funded by the state education department. The clearinghouse gathered a group of national experts who reviewed the huge data bank of existing software reviews and made a list of 275 recommended software packages. The clearinghouse has a microcomputer laboratory at which teachers can preview software. It also circulates different sets of new software around the regional TEC centers for review and evaluation. The state, through the clearinghouse, plans to move more deeply into software evaluation in the future. It will be getting into the New York-based Educational Products Information Exchange (EPIE), a nonprofit group that has done a good deal of software evaluation. The clearinghouse hopes to enter into joint efforts with the private sector to improve the quality of educational software.

Florida

In the last five years, Florida has embarked upon a statewide effort to improve the quality of its public education system. The integration of technology into school curricula is a part of its program. Florida was the first state with a legislative mandate

> to use computers and related technology to make instruction and learning more effective and efficient and to make educational programs more relevant to contemporary society... [by] providing information and consultation... establishing agreements with vendors... surveying districts... [and] conducting evaluations of available equipment or programs....

This bill was passed in 1981. The department of education had played a guidance role with local school districts since 1977, when it formed the Florida Educational Computing Project (FECP) "to provide technical services in the administration and technical use of computers."

From 1977 through 1981, the state allocated $6 million for the purpose of integrating computers into the state's public schools. To implement the 1981 mandate, the Florida Educational Technology Section (FETS) of the department of education was formed from the earlier FECP. FETS houses a computer lab for teachers to preview equipment; it also oversees all school computing activities in the state. It contracted with the University of South Florida in Tampa, giving it a $50,000 yearly budget, to establish a center for instructional computing to conduct software reviews and house a microcomputer lab.

In 1983, FETS gave the Orlando and Fort Lauderdale school districts $7,000 each to collect information on exemplary computer education programs in Florida. The Orlando district collects information on exemplary computer literacy programs. The Fort Lauderdale district collects information on successful teacher training programs. FETS then reproduces and distributes these model programs to all districts in the state. Teacher training and curriculum development are both done at the district level. FETS and these districts serve as clearinghouses of information. School districts in Florida are so large (there are only sixty-seven in the state) that regional centers could not possibly serve as gathering points for teachers from twenty or thirty of them. The district level itself is almost a regional organization. In summary, although the FETS role is limited, its importance should not be underestimated. Much of the recent progress at the district level would not have occurred if FETS were not acting as a facilitator.

In July 1982, the Florida legislature funded two regional centers of excellence in mathematics, science, and computer literacy

with a budget of $100,000 each. The 1982 FETS budget was $310,000 for salaries, expenses, and other personnel services (including the cost of the two regional centers). FETS had another $450,000 for its Florida Information Resource Network (FIRN) project, a multiyear plan to connect the state electronically so that, for example, a rural district in the north can use software from a large urban district like Miami 500 miles to the south. The 1983 FETS budget was $215,000. The money for personnel services was cut. However, the FIRN budget was increased to $2.7 million and will cover the costs of the personnel services.

FETS has limited resources for consulting with individual school districts—mainly giving them advice on how to go about establishing programs—and requires districts to submit an educational plan for computer-related purchases over $6,000. Florida is in a better position to do this than most states due to the small number of its districts.

For the 1983-84 school year, the state of Florida has budgeted $16.6 million for school computing activities, $10 million of which will be given to districts (based on their student population) for the purchase of hardware and software. FETS expects this to speed up the process of making every student in Florida's public schools computer literate and that it will also even out computer usage across the rich and poor districts, where there has been inequity. In October 1982, a FETS survey found that 13.5 percent of Florida's students used computers in their schools, up almost 100 percent from the previous year. With the $10 million funding program, FETS expects this number to jump much higher in the next few years.

FETS has established statewide contracts for computer hardware and software of many makes and models. The contracts give districts discounts on their purchases without narrowing their options. FETS is also an institutional member of MECC, thus gaining the right to distribute MECC software throughout the state. Florida, along with California and New York, is a part of IBM's program to donate computer equipment to selected schools. All three states are sites of major IBM operations.

FETS also publishes a monthly newsletter that lists district computer resource people and a booklet describing what many districts are doing.

Minnesota

The Minnesota Educational Computing Consortium (MECC) is the public organization responsible for computers in Minnesota's schools. It was established in 1973 by the Minnesota Department of Education. Although MECC is funded through the department, it is a separate organization and is being converted to nonprofit status to circumvent cumbersome public regulations. MECC's 1982 budget was approximately $8.8 million, $1.5 million of which came from the state. (Most of the rest was "special revenue" from sales of equipment and members' dues.) MECC supplies instructional computing services and software to school districts in response to requests. MECC materials are meant to complement, not compete with, materials schools get elsewhere.

MECC originated as the core of a time-sharing network in Minnesota. But, as microcomputers became less expensive, schools converted to them, and MECC adapted to the change by moving into support services, especially software development. MECC developed a state contract for hardware with Apple and, more recently, with Atari, so that schools can buy their machines at discount prices. It has not done business on a large scale with other microcomputer manufacturers.

MECC has developed a network of institutional members outside Minnesota. These members receive its services and may distribute MECC products to other districts within their states. The institutional member's fee is determined by the number of districts that it serves. It is $3,000 annually ($4,500 the first year) plus $300 per district ($600 for a district with more than 5,000 students). The institutional member can charge its constituency as it sees fit.

MECC reports that requests to it for in-service teacher training on microcomputer use are "overwhelming" at present. During the 1982-83 school year, it conducted 55 courses and 155 workshops. MECC develops software that it makes available to members at no charge, and it evaluates commercial software available to the schools. Coordinators test the programs in the classroom and write up their reviews in the MECC newsletter. The MECC central office has an extensive software library of programs for teachers to preview before buying. These programs are accompanied by reviews that also guide teachers. Companies donate software to MECC in an attempt to bring their materials to the attention of the educational market. Every spring, MECC surveys all teachers in Minnesota to find out what their needs are, and plans its activities for the next school year accordingly.

Every school in Minnesota is involved with instructional computing in some way. Computers are used in almost every curriculum area, for drill and practice, tutorials, simulations, word processing, and programming. When the state started its time-sharing network, it set aside funds to support the more distant districts' communication fees and, thus, involved them from the beginning of the project. When the time-sharing system was phased out as microcomputing became preferable, the impetus to buy the machines was already present in all the districts. Public education in Minnesota is 70 percent state funded, so the differences in school budgets due to local property values are minimized.

Minnesota schools can purchase computers out of their capital budgets rather than their operating budgets. Until recently, when New York State passed a bill allowing its schools to do so, only Minnesota schools had this capacity. It is an important one because it opens up more funds for investment in computers.

MECC's central office is in St. Paul with a staff of 125, of whom 45 work part time. It has five regional offices, each directed by an educational coordinator.

New York

The New York State Department of Education, early in 1982, created the Center for Learning Technologies (CLT) in response to criticism from teachers that the department was not helping them promote the educational uses of computers. Located in the State Cultural Education Center in Albany, the CLT now coordinates state educational activities in technology. The center houses microcomputer labs equipped with software and hardware with which teachers may familiarize themselves. It is also the clearinghouse for New York State software and hardware evaluations. The CLT offers general consulting services, an information exchange network, and software demonstrations (in its microcomputer labs). It assists in negotiating group purchases for software, develops statewide contracts for computer hardware and, through the CLT media network, electronically provides constituents with software. Early in 1983, the CLT published a directory of all the teacher training programs available in New York State colleges during the summer.

In March 1983, the Center for Learning Technologies set up six regional centers, called demonstration and technical assistance centers, to provide local support to school districts. The CLT envisioned that each center would develop in-service courses in

computer-related instruction, provide workshops on computer literacy, evaluate courses for credit that are offered by local colleges, and assist schools through on-site visits. In reality, the services of most of these centers are less comprehensive, due to the size of their budgets.

The New York City center offers more services than most because its activities are also financed by the New York City Board of Education. The center was set up with city capital funding of about $200,000. Its budget last year was about $240,000, much of which was generated by fees for teacher training programs and from software companies whose software was reviewed by the center (schools cannot buy software unless the center has reviewed it). This budget figure does not include the salaries of the center's staff, which are paid for by the division of curriculum and instruction. The New York City Board of Education also has a $2 million mathematics-science grant that will pay for a program to provide each of the thirty-two districts in the city with an $11,000 package consisting of two personal computers. One will be equipped with LOGO for use in an elementary school, and one equipped with a variety of other programs for instructional use in a junior high school.

The New York City center trained more than 5,000 teachers last year in its center and in thirty satellite school training centers that it established. It has a software library of over 700 disks, each containing a variety of programs on a specific subject. The center serves as the local distributor of MECC software and houses a microcomputer lab where teachers can learn about computers and preview software. Schools may purchase only center-approved computers and can do so at substantial discounts because of standing bids by the center.

New York has a strong relationship with private industry. Since March 1983, Commodore, Honeywell, and IBM have all announced plans to donate computer equipment to New York State schools. Commodore will donate sixty microcomputers. Honeywell is giving a $100,000 minicomputer system complete with companion software. IBM has made New York State a part of its program to donate 1,500 IBM personal computers to public schools in three states (the others are California and Florida). Twenty-eight New York schools and the six regional training centers will receive a total of 480 IBM personal computers this year.

New York—as well as California, Florida, and Minnesota—is starting to work directly with computer companies to develop

software. New York officials and teachers have met with nine large software distributors and developed a uniform format for software review. The CLT held a software colloquium in July 1983 for publishers, reviewers, authors, and state educators to discuss the evaluations and how to go about improving software, and it has planned another colloquium for January 1984. Software publishers involved include the Encyclopaedia Britannica Education Corporation; Harcourt, Brace, Jovanovich; Houghton Mifflin Company; Random House; and Honeywell. These software publishers provide the CLT with free copies of their products for review and pretest some software at the CLT before offering it on the market.

New York is the home of the Educational Products Information Exchange (EPIE) Institute, a nonprofit software evaluation center in Stony Brook. The institute, associated with Teachers College of Columbia University, provides software reviews to schools nationwide. The state is also planning to set up its own software clearinghouse.

Summary

Council researchers have found that state involvement in computer education, in the form of funding, information, and coordination of local efforts, helps to increase equity across school districts. State involvement also enhances interdistrict communication and cooperation. In coordinating local efforts, states give educators the opportunity to meet with each other and exchange information on both the successful and unsuccessful aspects of their programs.

In these four states, state-level leadership has drawn on local efforts but has been careful not to smother them. Experts in the field of computer education are found, by and large, at the local level. Local educators have played a large role in determining the directions the states have taken in promoting computer education programs. The study states have designated one or two people as full-time computer education coordinators and have given them responsibility for coordinating the further development of computer education programs.

5. State Leadership in New Jersey

No statewide coordination exists among the local efforts to use computers in New Jersey schools. In the past, the New Jersey Department of Education helped local districts develop computer-related curricula and train teachers through four regional Educational Improvement Centers (EICs). These centers, however, were closed recently and replaced by three Regional Curriculum Service Units (RCSU) that provide assistance in all areas of curriculum development.

The New Jersey Department of Education has assigned responsibility for providing technical assistance to local school districts regarding the educational uses of technology to a newly established Educational Technology Unit within the Division of General Academic Education. This unit will help districts establish exemplary computer literacy programs, evaluate hardware and software, identify available resources, and develop in-service training workshops. These activities will be carried out in collaboration with the offices of the county superintendents, the RCSUs, and institutions of higher learning. The principal conduit for service delivery is expected to be the RCSUs. These three regional units, once fully operational, will have approximately twelve staff members each. One or two members of each staff will be specialists in microcomputer use. The average annual budget for each of these centers is approximately $316,000, a small portion of which will support computer use services.

From 1977, New Jersey's Educational Improvement Centers had provided computer information services, resource collection and distribution, and instructional materials. They sponsored conferences on educational issues related to computers and handled extensive in-service teacher training both at the EICs and at

local schools. Software was available for preview by teachers and practice on the computer was possible. The Northwest and Northeast EICs trained about 1,000 teachers over a period of five years.

Educational Information Resource Center

In South Jersey, constituents of the EIC in Sewell (in Gloucester County) lobbied successfully in support of special legislation to set aside $500,000 to maintain their center, now called the Educational Information Resource Center (EIRC). The Sewell EIRC is independent of the department of education. State funds make up one-third of its operating budget. The remaining funds are from competitive grants from the National Institute on Education, the Office of Juvenile Justice, the Comprehensive Education and Training Act (CETA) programs, and other organizations. Its staff consists of fifteen to eighteen base personnel and forty to fifty employees who are working on special projects.

The Sewell EIRC has a good working relationship with the Wayne Consortium. EIRC prints and distributes, in cooperation with the consortium, MECC computer literacy materials and teacher guides. The Wayne Consortium has donated a collection of MECC software to the EIRC.

The Educational Information Resource Center's microcomputer coordinator and three part-time microcomputer consultants teach computer education courses in schools throughout southern New Jersey. In response to district requests, the EIRC has trained approximately 400 teachers during the past year. The EIRC offers workshops on VISICALC, graphics, word processing, LOGO, and general uses of microcomputers.

As of August 1983, the center had fifteen microcomputers, purchased over the past several years. Teachers may preview public domain, commercial, and MECC software in this facility. Timex, Inc. has expressed an interest in using the EIRC as an educational demonstration center for its products.

New Jersey Institute of Technology

The New Jersey Institute of Technology in Newark has recently taken steps to develop a cooperative relationship between secondary and postsecondary educators. Since 1982, NJIT has offered computer education courses to precollege students. Approximately 600 students have attended its summer and afterschool classes in the past year. NJIT's computer center houses ten Digital microcomputers for precollege use. In the 1982-83

school year, NJIT offered a one-semester course for high school students. In the past two years, NJIT has held classes on the educational uses of computers that were attended by about 200 teachers. The teachers, with backgrounds primarily in mathematics and science, received certificates from NJIT's continuing education program.

The Center for Information Age Technology (CIAT), located at NJIT, was funded in 1983 with $550,000 in seed money from the state government. NJIT shared the original appropriation with the Department of Higher Education. The CIAT will target its programs toward education as well as government and business. For teachers, the CIAT plans to expand the NJIT computer center and offer one-day training sessions, dealing with the selection, purchase, and evaluation of educational software and hardware.

NJIT is initiating a statewide computer communications network, called the Electronic Information Exchange System (EIES). The system offers continuous group conferencing with permanent transcripts for each participant, database access, and individual or group message capability. In the field of computer education, the network can facilitate the exchange of information on educational hardware and software among districts. It can also serve as a clearinghouse for software evaluation and as a library of public domain software. In September 1983, the data base included instructional materials in mathematics, science, chemistry, biology, physics, and the social sciences. Capacity has been reserved for other subject areas. The membership fee for the EIES data base is $70 per month.

Governor Kean's Proposals

In February 1983, Governor Thomas H. Kean expressed his belief that "we must raise the level of expertise of all our students... to meet the demands of our future economy." His 1983 budget appropriated $10 million to implement the preliminary recommendations of the Commission on Science and Technology. These included increasing academic and industrial collaboration on software development; establishing four high-technology research centers to concentrate on five areas, among them computers; and expanding the Center for Information Age Technology (at the New Jersey Institute of Technology), a section of which might work to promote computers in education. Further proposals are expected in the Governor's budget message for fiscal year 1984-85.

Summary

Some resources are available to help local school districts in New Jersey train staff, choose programs and hardware, and set up and improve efforts to use computers in the schools. But the extent of resources provided by the state government has been curtailed in recent years with the closing of the Educational Improvement Centers. Their replacements, the three Regional Curriculum Service Units, must try to help in all areas of curriculum development with fewer staff members and less money.

Other resources available include the Educational Information Resource Center in Sewell and the Center for Information Age Technology at the New Jersey Institute of Technology. While these provide considerable assistance, in cooperation with consortiums of local school districts, the state government is not currently providing needed leadership in the area of computer instruction.

6. Conclusions

School districts throughout New Jersey have begun to develop programs in computer literacy. Developments in this area of education, however, are occurring unevenly across the state. Wealthier suburban districts are exposing large numbers of their students to the technology, while poorer urban and rural districts are struggling to acquire the hardware. On the whole, it appears that local school districts in New Jersey incorporating computers in their classrooms are inadequately informed about each other's efforts. Moreover, state education officials and some local educators fear that many districts are proceeding in this area without having developed clearly defined educational goals to be achieved with the technology.

New Jersey schools lag behind those in states that have been identified as leaders in the use of computers in the classroom. We believe this has come about primarily because New Jersey's local school districts have developed their programs in a sporadic and uncoordinated fashion. There has been limited involvement of and little leadership from the department of education in this evolving area of education. State education departments in Florida, New York, and California, for example, are setting up agencies or hiring staff to deal solely with educational technology, focused primarily on the computer. These states are also appropriating funds to assist local districts; they have definite policies for computer use in the schools, and some have established computer literacy for all students as a goal for the near future.

In such critical areas as curriculum planning, teacher training, hardware and software evaluation, and program funding, New Jersey has contributed little in a systematic way to its local districts. As a consequence, school districts that are among the state's

wealthiest have been able to allocate funds to establish computer education programs while others have not. In view of this reality, the need for state leadership seems clear. It is only through active involvement by the New Jersey Department of Education and the state legislature that the resources for program planning, hardware and software evaluation and acquisition, teacher training, and information sharing can be made available on an equitable basis.

Many New Jerseyans recognize the growing influence of the computer on our lives. Equally clear is a recognition of the need to equip New Jersey's students with the skills essential for success in a society undergoing rapid changes induced by the computer. The Council on New Jersey Affairs believes that with this recognition should come action. The recommendations that follow are offered in the hope that our state will begin to move more effectively onto this new frontier of education.

- *New Jersey should establish a "Technology Equity School Fund" in the amount of $15 million to be distributed over a period of five years to the state's poorer districts to help ensure that these districts have resources to develop computer literacy programs for their students.*

The disparity in performance between students in rich and poor school districts in New Jersey is well documented. This issue has been a statewide concern for many years. Now concern is growing among educators that poor districts will fall even further behind as a result of their inability to fund computer literacy programs. Concern about the issue of equal access to computer literacy is shared by some political leaders. U.S. Senator Frank Lautenberg recently stated that the capacity to use and work with computers is becoming essential—almost as essential as the ability to read and write. He warned, however, about the widening gap between the rich and the poor and suggested that failure to address the problem of equal access to the technology could result in a high degree of computer illiteracy among the poor.

Several bills have been introduced in Congress to fund computer acquisition by local school districts or to offer tax incentives to companies that donate computers to schools. A bill introduced by Senator Lautenberg, the Computer Education Assistance Act, targets funds to poor school districts.

Recently, New Jersey Assemblywoman Marie Muhler introduced a bill in the state legislature, the "Computer Literacy Act," which provides for the establishment of five computer education pilot projects. The purpose of the pilot projects would be to

advance the computer capabilities of students from kindergarten through twelfth grade, especially in those districts that to date have been unable to establish computer science programs. Assemblywoman Muhler's bill calls for an appropriation of $50,000 for this purpose. Although this proposal is a step in the right direction, it falls far short of what appears to be needed.

We believe an investment by New Jersey to help ensure that every school district, regardless of wealth, has the resources to acquire the equipment and supportive material necessary to establish programs in computer literacy would be a wise one. The funding program we propose is modest. It is intended to provide a base of financial support for computer literacy program development in districts with limited resources. These funds should be targeted to the state's poorer school districts for computer acquisition, software purchases, and teacher training. We believe this program should be funded at the level of $3 million a year for a period of five years. We further believe these funds should be directed to those districts whose equalized valuation per pupil is 60 percent or less of the state average. This would cover approximately 80 of New Jersey's operating school districts, which serve approximately 350,000 of the state's 1.1 million students. (These figures are based on an analysis of New Jersey school district expenditures in 1981-82 by Margaret E. Goertz, Educational Testing Service, May 1983.) Eligible districts should receive a share of these funds in proportion to the number of students enrolled in the district's schools; i.e., a district with a student population equal to 10 percent of all students in eligible districts, should receive 10 percent of the funds. No district, however, should receive less than $25,000. Targeted in this manner, these funds would assist those districts with the highest concentration of minority students and special-needs students (compensatory education, bilingual, and special education pupils).

We would emphasize that the current state of affairs where richer school districts are advancing speedily into the computer age is exacerbating a fundamental problem of American society by increasing the disparities in job opportunities and life chances between rich and poor and between black and Hispanic and white students in our nation.

- *The New Jersey Department of Education should play a more active role in support of all local school districts' efforts to develop computer literacy programs.*

  New Jersey's leaders have a vision of the state's future eco-

nomic prospects that depends heavily on the growth and expansion of high-technology firms. The Governor's Commission on Science and Technology, for the past year, has been investigating ways of ensuring that this state will continue to be among the leaders in the high-tech field. The Commission's Task Force on Technology-Trained Manpower states in its draft report that New Jersey schools must place special emphasis on improving science and mathematics skills and developing problem-solving capabilities and computer literacy at every grade level. To achieve these objectives, many New Jersey school districts will require help. That help, especially in the evolving area of computer literacy, should be provided by the state education department.

In order to take the leadership role envisioned, the department will have to upgrade its knowledge base. At present, several districts possess expertise in computer use in schools far superior to that of the state education department staff. The department should learn from these local successes, gaining insights that can be used in assisting those districts where computer education programs are in the early stages of development. The department should develop the capacity to assist local school districts in defining computer use objectives and the means to achieve those objectives. It should be able to provide guidance regarding the pitfalls to be avoided in the development of computer literacy programs. Moreover, it should develop and publish high-quality planning guides and it should develop statewide purchase agreements with computer companies that would allow local districts to purchase equipment at reduced prices.

- *New Jersey should establish an information clearinghouse to which teachers can turn for assistance in evaluating computer hardware and software.*

We are in a period of rapid growth in the development of computer hardware (machines) and software (program disks, tapes, and cassettes). The variety of equipment now available on the market allows prospective users to select the equipment best suited to their needs from a wide range of choices. Developments in software variety have not been as rapid, but this area is gaining momentum in response to the increased sophistication of the hardware and the demands of computer users.

School administrators and teachers, faced with the range of hardware available and the necessity of deciding which piece of equipment is best suited to a particular educational purpose, will require: (1) familiarity with the capacity of different machines, (2)

knowledge of software needs, and (3) awareness of the availability of appropriate software. These capabilities are present in few New Jersey districts.

States where computer use in schools is progressing have established, or are working toward establishing, central clearinghouses where local school personnel can obtain assistance in selecting materials best suited to their needs. New Jersey should establish a clearinghouse to assist its local districts, whose personnel have neither the time nor the money to travel across the country for help. California's Software Library and Clearinghouse in San Mateo is an excellent model from which New Jersey could learn a great deal.

The New Jersey clearinghouse, like California's, should compile the collection of hardware and software reviews that other states and individual districts have developed. It should also tie into New York's Educational Products Information Exchange (EPIE) to get copies of all its reviews and should assume responsibility for distributing, at low cost, all Minnesota Educational Computing Consortium (MECC) software to local school districts. This latter task will require some coordination with the Wayne Consortium, a group that currently distributes MECC software in northern New Jersey.

In addition to performing the functions described above, the clearinghouse could also serve as the lead agency in establishing a collaborative relationship between school districts and software publishers. Criteria should be identified with the help of software publishers and teachers to increase the quality of educational software and develop programs that respond to the needs of teachers. Periodic forums of teachers and publishers to discuss new software should be organized by the clearinghouse. Such forums would allow software publishers to get feedback from the teachers who preview their products.

Using the California model in New Jersey suggests the possibility of designating the recently established Regional Curriculum Service Units (RCSU) as the mechanism through which a statewide clearinghouse function could be performed. This would require allocating additional funds to these units in order to carry out additional functions.

- *Local school districts should provide in-service training for teachers in the educational use of computers. This training should be encouraged and supported at the state level of government.*

Due to declining enrollments and the low rate of teacher hiring, in-service training is the area of greatest potential in staff development. Local districts are moving along many paths to accommodate this. Schools are training their own staff as well as paying for teachers to take courses at nearby colleges. They are limiting the use of outside consultants because of high costs. Group efforts are also developing among computer-using school districts. Demand for staff development outstrips supply, and districts are searching for new training programs.

The department of education must assume a larger role in teacher training. The least costly function that the state should perform is gathering, reprinting, and circulating to all New Jersey school districts exemplary curricula and teacher training programs from around the state and country. The department should also publish a directory of computer education courses offered by colleges, the Network for Action in Microcomputer Education (NAME), the Sewell Educational Information Resource Center (EIRC), New Jersey Institute of Technology (NJIT), local schools, and any other public or private organizations that offer training programs.

- *The New Jersey Department of Education should expand its role in facilitating private-sector involvement in support of computer education programs in New Jersey's elementary and secondary schools.*

California, Minnesota, and Florida schools have been the recipients of computer hardware and software from the private sector. In some instances, the contributions have been made in response to state tax incentives available for such purposes.

We believe New Jersey firms would be inclined to contribute equipment, technical assistance, and other resources in support of school-based computer programs if the state had a mechanism through which contributions could be facilitated. Several New Jersey firms have already expressed interest in a program of this type coordinated by the state education department. If some form of tax incentive were offered contributing firms, we believe participation would be favorably affected.

As an example of what might be possible in this regard, a recent development in the city of Newark is instructive. There, IBM is equipping a computer training program to be operated by the Urban League of Essex County. Local firms are contributing funds to rent and remodel space, and foundations are contributing funds to help staff the center. Although the center is not affiliated

with the local school system, the willingness of the private sector to contribute considerable resources for its establishment suggests that the private sector regards this area of education as one in which it can play an important role.

We believe the New Jersey Department of Education should seize the opportunity to perform the coordinating and facilitating function that potential private-sector participation will require.

This report is an attempt by the Council on New Jersey Affairs to highlight an important issue in education. The debate over the appropriate uses of the computer in education is growing in intensity. We suspect this debate will continue for an extended time. Our view, however, is that while the debate goes on, some children are being denied the opportunity to work with this technology. In New Jersey these children tend to be concentrated in the state's poorest school districts. We believe this is an inequity that should be redressed. Decisions to use computers in the classroom should be based on their perceived contribution to the education of children—not on the wealth of the school district. This issue, we believe, is one that should receive the immediate attention of state policymakers and warrants timely action.

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